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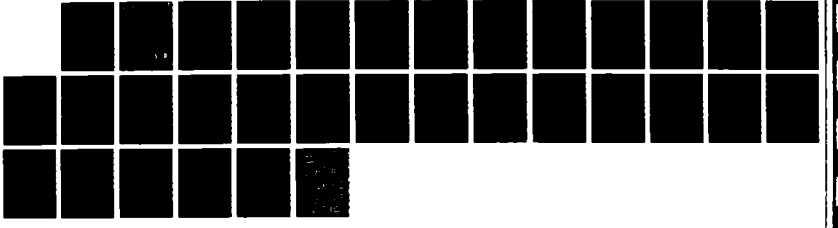

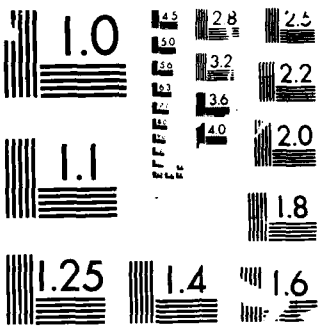

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This study attempts to determine if the use of electrocardiograms in a population 40 years of age and older is an effective screening tool to identify latent cardiovascular disease.

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TO DETERMINE IF THE ELECTROCARDIOGRAM IS AN EFFECTIVE SECONDARY PREVENTION MECHANISM TO PREVENT CARDIOVASCULAR DISEASE

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SUBMITTED TO THE FACULTY OF
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Requirements for the Degree
of
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by

Captain Samuel H. Robinson, MSC

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CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

BACKGROUND

Critical examination and testing of the efficacy of annual physical examinations has been addressed from the standpoint of the benefit of such examination on the outcome of specific diseases.[1] Increasing popularity of the use of annual physical exams was promulgated by the American Medical Association in 1922.[2] Since that time the use of such exams has become widespread throughout the medical profession. The efforts of the medical profession to promote annual examination has given birth to the expectation by the general public of the supposed benefit of such examinations. Thompson, referring to the annual physical being used by Family physicians as a preventive intervention, stated that there has evolved a "massive and inappropriate over-expectation on the part of the general public as to what physicians at the level of office practice can deliver".[3] The public's opinion has evolved to such a degree that in general, it is expected that the outcome of a disease process, identified by periodic health examination, can be altered. This has been shown not to be true, however, the expectation still persists.

The annual physical examination is one intervention technique in the disease chain from identification of risk factors to complications and death from that disease. Figure 1 demonstrates the three types of disease prevention and their appropriate interjection into the disease chain.[4] The annual health examination is a secondary prevention measure designed to identify disease in an otherwise asymptomatic population. Assessment of risk factors, particularly of the leading causes of death in the United States, must be completed prior to any screening procedure being incorporated into an annual examination. The efficacy of the

annual health examination, in and of itself, and despite massive screening efforts, is questionable since there are only a few diseases for which early detection could effect the outcome in a beneficial manner.[5]

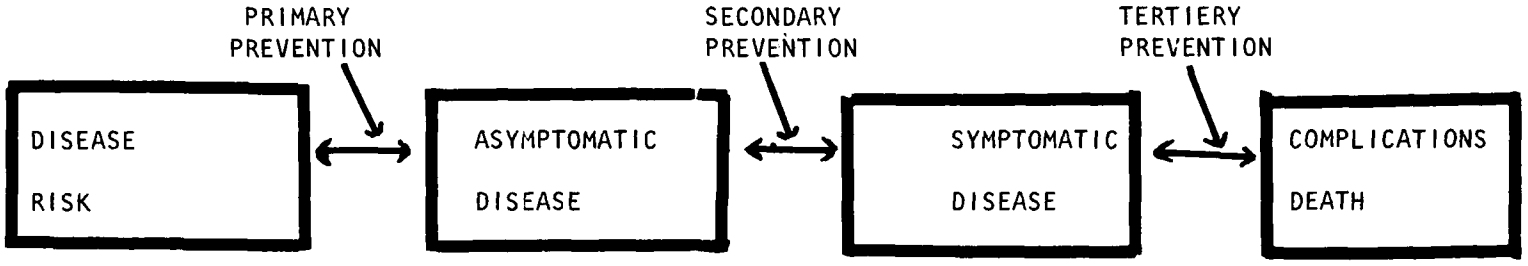

Figure 1: Intervention in the Disease Process.

The theory being ascribed to currently regarding prevention is that primary prevention through active intervention to eliminate disease risk factors will in the long run have a greater impact on overall health status than will secondary or tertiery measures. McKinlay and McKinlay reported in 1977 that chemotherapeutic and prophylactic medical measures have not significantly contributed to the decline in mortality in the U. S. since 1900.[6] The victory over infectious disease has permitted more people to survive to old age. Thus chronic medical conditions, not previously observed due to low survival rates, have become the nemisis of modern medical care. To this end the proliferation of medical technology has accomplished little to further the decline in mortality and has only served to prolong life.

The literature is replete with descriptions of screening tests which should or should not be performed during annual physical assessment. The electrocardiogram has been one of these tests and has become suspect with regard to the effectiveness to screen for latent cardiovascular disease. An effective screening test should be able to detect a disease prior to any clinical manifestation of that disease.

The efficacy of using the annual physical as a screening mechanism to detect latent disease has prompted scrutiny of the exam itself and the components of the exam and their resultant effect on health status. This paper is designed to examine one of these components. In an era of scarce resources the health care industry, of which military medicine is a component, must insure that the expenditure of resources has the greatest impact. In the case of the annual physical and its components, this impact has come increasingly questionable.

STATEMENT OF THE PROBLEM

Although slowly changing, the use of the annual health examination has continued to be used in the hopes of discovering latent disease in an asymptomatic population. The use of the periodic health examination first came to prominence in the military during World War I. At that time screening was conducted of potential inductees. Officials were properly surprised at the number of rejections due to physical shortcomings. Similar experience, despite attention during the interim years to physical fitness, was experienced during World War II.[7] Standards of fitness have been developed within all the military services along with a required periodic reassessment of individual health status. The mandatory nature of these exams and the requirements to maintain an effective fighting force, have instilled in service members the habitual desire for an annual checkup. Moreover, the prospect of free medical care even into retirment from active service, has been instrumental to the establishment of and the demand for annual health exams beyond the point of retirement. The current scarcity of medical resources, particularly at small installation treatment facilities, has dictated that the administration of complete annual physical exams for retirees not to be feasible. Given the accumulation of data regarding the efficacy of exams there would appear to be no detrimental effect upon that segment of the population by continuing this policy. Attesting to this is the change in Army Regulation 40-501 deleting the retirement physical as a mandatory requirement and elimination of the requirement for annual physicals after age 40.

The question of disease prevention however, still persists. This study is not designed to examine the efficacy or desirability of performing annual physical exams. In order to apply resources in an efficient manner examination of disease

patterns in aging populations is paramount. Certain aspects of the periodic health examination can contribute to the most efficient allocation of medical resources, both human and physical. To this end the use of screening techniques to identify latent disease which will affect future patterns of medical care must be examined. To examine critically all the various tests and procedures which encompass a "complete physical examination" is beyond the scope of this paper. Therefore, the target of the study was to determine if the use of electrocardiograms in the population 40 years of age and older is an effective screening tool to identify latent cardiovascular disease.

METHODOLOGY

Electrocardiograms are performed during periodic physical examinations for soldiers and retirees. In order to judge whether the EKG is an effective tool to identify latent cardiac disease an examination of patient treatment records was conducted.

Data was obtained by reviewing outpatient treatment records and records of those inpatients admitted with a primary diagnosis of myocardial infarction in 1979 and 1980. In an effort to limit the scope of the research only those records belonging to a military sponsor were examined. Approximately 150 records were screened. Fifty-six were considered usable. Records considered unusable had no record of an EKG or no indication that the EKG had been evaluated. Information extracted from the record included the EKG findings, cardiovascular risk analysis factors, evidence of cardiovascular disease, age, sex and eligibility status (e.g., active duty, retired, etc).

This raw data was grouped into four categories of patients to show the relationship of EKGs and CVD. The category totals were placed in a 2 x 2 contingency matrix and evaluated using a CHI-square test for independence.

An additional set of data was grouped and evaluated in the same manner to determine the independence or dependence of cardiovascular disease and the presence of risk factors in a patient's history. The first test was conducted at the .01 level of significance with 1 degree of freedom. In the second test .05 was used as the level of significance.

OBJECTIVES

1. To research medical records filed at Kenner Army Community Hospital and extract those records pertaining to active duty soldiers and retirees who are over 40 years old.

2. Randomly select retirees to participate in the study if sufficient medical records are not available in the Outpatient Record Department.

3. A critical examination from the literature will be conducted concerning the epidemiology of cardiovascular disease and the relative merit of the EKG results.

CRITERIA

The literature varies somewhat with regard to acceptable criteria for evaluating screening techniques. Since most sets of criteria overlap to a degree the criteria used by Frame is arbitrarily selected and presented in Figure 2.[9]

LIMITATIONS

Some treatment records had been removed from the records room subsequent to the 1976 termination of retiree medical care, however, there were on file sufficient numbers of records to conduct the research and obtain a data base.

The severest limitation related to the documentation in the records. There were numerous EKG reports that were not dated. Evaluations of EKGs was not contained on the EKG face sheet in some cases. Exhaustive examination of the progress notes had to be made to determine the date of examination and the findings and largely counteracted the lack of documentation. Fortunately, the physicians made sufficiently detailed progress notes to allow the data to be valid.

ASSUMPTIONS

It was assumed that the groups studied did not have any cardiac disease identified prior to their 40th birthday.

It was assumed that those persons over 40 years old who had retired did so because of length of service or a noncardiac related disability retirement.

That the requirement in AR 40-501, para 11-11b for an EKG to be obtained

on all soldiers on their 40th birthday and annually thereafter, to serve as a diagnostic and screening tool will be retained.

FIGURE 2

Screening Criteria*

1. The disease must have a significant effect on the quality or quantity of life.
2. Acceptable methods of treatment must be available.
3. The disease must have an asymptomatic period during which detection and treatment significantly reduces morbidity and/or mortality.
4. Treatment in the asymptomatic phase must yield a therapeutic result superior to that obtained by delaying treatment until symptoms appear.
5. Tests must be available that are acceptable to patients, at a reasonable cost, and that detect the condition in the asymptomatic period.
6. The incidence of the condition must be sufficient to justify the cost of screening.

*Adopted from Frame, Paul S. "Periodic Health Screening in a Rural Private Practice", TJFP Vol 9 (L) (1979)

CHAPTER II

DISCUSSION

CHAPTER II

DISCUSSION

PRESENTATION OF DATA AND STATISTICAL ANALYSIS

The hypothesis was made that if the EKG could predict the presence of cardiovascular disease then there would be a direct relationship between these two criteria. The medical records were screened to discover if the patient had an EKG after his or her 40th birthday and to attempt a correlation between the initial and subsequent EKGs and evidence of cardiovascular disease. As an afterthought data was also collected regarding any risk factors which a patient may possess that would directly impact on their cardiac status. Figure 3 demonstrates the initial data format.

RAW DATA COLLECTION FORMAT

Date of Birth	Social Security No.	Sex	Category	EKG & Findings	Risk Factors	Cardiovascular History

Figure 3

Fifty-six usuable records were obtained. After the initial data was collected it was further tabulated into four categories by patient as demonstrated in Figure 4.

TABULATION OF CRITICAL VARIABLES FORMAT

Case #	Normal EKG (N) (+) or (-)	Abnormal EKG ($\bar{N}$) (+) or (-)	Evidence CVD(C) (+) or (-)	No Evid CVD ($\bar{C}$) (+) or (-)	No of Risk Factors 1-5
Total					

Figure 4

Once the data was tabulated as in Figure 4 an analysis was made to discover all cases who had combinations of N,C; N,$\bar{C}$; $\bar{N}$,C; $\bar{N}$,$\bar{C}$: Table 1 shows the final totals in each category. Appendix B displays

	CVD(C)	No CVD($\bar{C}$)
Normal EKG (N)	17	20
Abnormal EKG ($\bar{N}$)	14	5

Table 1

The CHI-square (X^2) test of independence was applied with one degree of freedom at a significant level of .01. Evaluation results showed a calculated $X^2 = 3.908$. The table of CHI-square distributions for one degree of freedom and $\alpha = .01$ indicated $X^2 = 6.635$. Since the null hypothesis was that the use of an EKG and evidence of CVD were independent and the value of X^2 calculated is less than X^2 the null is accepted. Therefore, the two criteria can be said to be independent of one another. This finding is consistent with the literature particularly the findings of the Canadian Task Force on the Periodic Health Examination.[10]

An additional test was applied to determine if cardiovascular disease was related to the presence or absence of risk factors. Current theory states that life-style habits have a greater significance of health status than clinical intervention. With this in mind the same statistical test was applied for CVD and risk factors. The null hypothesis was that the two criteria are independent of each other. This was in fact the case. Table 2 illustrates the findings and results of the test.

	Risk Factors		No Risk Factors		
CVD	23		8	31	$X^2 = 2.043$
No CVD	14		11	25	

Table 2

It is apparent from the difference between the calculated X^2 (2.043) and the X^2 from the Table of CHI-Square distribution (3.841) that the null hypothesis should be accepted. Given this result it would appear that evidence of CVD and the presence of risk factors in an individual's life style would be independent of each other. This finding is not consistent with current findings in the literature and may be the results of poor documentation in the medical records.

EVALUATION OF STATISTICAL DATA

Figure 5 summarizes the results of the preceding analysis.

DATA SUMMARY

Criteria	Calculated X^2	Table X^2	Ho	Level of Significance
EKG and CVD	3.908	6.635	Accept	$\alpha = .01$
CVD and Risk Factor	2.043	3.841	Accepted	$\alpha = .05$

Figure 5

The data supports the original premise that the EKG cannot predict the presence of CVD or more specifically a myocardial infarction. The statistical analysis applied is designed to test the independence of two or more criteria. Figure 5 clearly indicates these findings. At an $\alpha = .01$ there exists only a 1% chance of committing a Type I error. The chance of committing a Type I error can be considered acceptable since the preponderance of evidence in the literature also supports these findings.

The test of independence between CVD and presence of risk factors was conducted to satisfy the curiosity of the researcher. The findings have no bearing of the problem as stated in the introductory chapter.

The reliability of the data for the first test can be considered acceptable. Records in which documentation was absent or incomplete were rejected from the sample. All the records accepted had more than adequate documentation. The second test however, is less reliable. Many of the records used did not contain complete risk factor histories. There is a good possibility that some of the records that did not reveal risk factors by history did in fact pertain to patients who were overweight or smoked or had a family history of CVD. Contrary to the findings here, there does appear to be a strong correlation between the two criteria demonstrated in the literature.

CHAPTER III

CONCLUSIONS

CHAPTER III

CONCLUSIONS

SUMMARY

The focus of this study was to determine if the use of electrocardiograms in the population 40 years of age or older is an effective screening tool to identify patient cardiovascular disease. The previous chapter demonstrated that the two critical variables, EKGs and CVD, were independent of each other statistically. Figure 2 lists six criteria which a screening test must conform with if the test is to be effective.

Frame and Carlson used these six criteria to examine different diseases in order to develop an intervention plan which could benefit individuals' health status. Their conclusions were to not recommend the use of the cardiogram as a routine screening device. Their conclusions were supported by the analysis in the preceding Chapter. Criteria Number 5, Figure 2 cannot be satisfied since the EKG is an ineffective tool to identify CVD during its asymptomatic (latent) period.

The annual physical has been used as a maneuver to identify latent disease in order to ameliorate the adverse effects of disease through secondary preventive measures. Without effective tests as integral components of that exam that are designed to predict occurence of a disease prior to its symptomatic manifestation, the annual physical exam is rendered useless. One component, the EKG, has been used consistently in the military to identify CVD in persons 40 years of age or older. This study and others indicate that to continue this practice is a misuse of scarce resources which would be better allocated elsewhere. The evidence would support the hypothesis that the EKG is not an effective screening tool.

FUTURE CONSIDERATIONS

The implications of this study could be very broad in their scope. The prospect that results from annual physicals are of doubtful effectiveness, raises questions concerning how best to monitor the health status of our active duty military population and their dependents. Frame and the Canadian Task Force on Periodic Health Examination favor primary prevention measures focused on specific age groups within the population. The object of both these views is to prevent the occurrence of avoidable diseases or at least minimize the effect of illness on individual life-style.

The military community can easily benefit from a program directed at primary disease prevention. The effects of such a program on the mix of future medical services is open to speculation. It is reasonable to expect however, that if individual life-style behavior is modified in favor of healthful living, the demand for chronic illness care for this same population in the future would be decreased. Moreover, the health demands of this same population group as it ages should create a lower demand level on existing medical resources.

This is, of course, speculation. McKinley and McKinley and other researchers have pointed out that tertiary intervention will not measurably increase life expectancy. Medical intervention with all the technical aspects of current medical practice can merely prolong life. Moreover, there is no guarantee that prolonging one's life has any beneficial effect on that person's life-style. Further research in the area of life-style and its relation to health status will be required in order for people to take responsibility for their own health.

APPENDIX A

DEFINITIONS:

Annual Health Examination (Annual Physical Examination); a group of tasks that are part of a systematic complete "work-up" of a patient as undertaken by physicians based on standards of performance.

Screening tests: nondiagnostic procedures used to separate apparently well persons who have a disease from those who probably do not.

Mass Screening: screening done on a whole population or major subgroup.

Selective Screening: screening conducted with selected subgroups based on epidemiologically obtained research of high risk groups.

Primary Prevention: prevention of any clinical manifestations of disease (e.g., immunizations, wearing of seat belts).

Secondary Prevention: the early detection and treatment of established, but asymptomatic disease.

Tertiery Prevention: avoidance of complications, and rehabilitation and palliation for symptomatic disease.

Electrocardiogram (EKG or ECG). a graphic record made by an electrocardiograph, of the electrical forces produced by the contraction of the heart.

APPENDIX B

TABLE 3

Case Number	Normal EKG	Abnormal EKG	Evidence A CVD	No Evidence CVD	Number of Risk Factors
1	+			+	3
2	+		+		2
3		+		+	3
4	+			+	Ø
5		+	+		1
6	+			+	Ø
7		+	+		4
8	+		+		Ø
9		+		+	1
10		+	+		4
11		+	+		3
12	+		+		3
13	+			+	1
14	+			+	1
15		+		+	1
16	+			+	2
17	+			+	Ø
18	+			+	2
19	+			+	2
20	+			+	3
21	+		+		3
22	+			+	Ø
23	+			+	Ø
24		+	+		Ø
25	+		+		5
26	+			+	Ø
27		+	+		Ø
28		+	+		4
29		+	+		2
30	+			+	Ø
31		+		+	Ø
32	+			+	Ø
33	+		+		2
34		+	+		Ø
35	+			+	1
36		+	+		2
37		+	+		4
38		+	+		1
39	+			+	1
40	+			+	1
41	+			+	Ø
42		+		+	1
43	+			+	Ø
44		+	+		2

Case Number	Normal EKG	Abnormal EKG	Evidence A CVD	No Evidence CVD	Number of Risk Factors
45	+		+		Ø
46	+		+		Ø
47	+		+		2
48	+		+		2
49	+		+		Ø
50	+		+		4
51	+		+		Ø
52	+		+		3
53	+		+		1
54		+	+		3
55	+		+		3
56	+		+		1

Table 3 is a display of the critical variables and their relation to each other. The CHI-square test was applied directly to this data as follows:

	(C) CVD	($\bar{C}$) No CVD	
(N) Normal EKG	17	20	37
($\bar{N}$) Abnormal EKG	14	5	19
	31	25	56

The null hypothesis (Ho) states that the two variables N and C are independent. As stated in the test at $\alpha = .01$ with 1 degree of freedom X^2 calculated = 3.908.

The application of the CHI-square test for independence assumes the null hypothesis (Ho) to be consistent with the independence of the two criteria in question. Utilizing the formula

$$X^2_{\text{Calculated}} = \sum \frac{(O-E)^2}{E}$$

O - observed frequency
E - expected frequency

A value of X^2 can be determined. If this calculated value is less than X^2 presented in a CHI-square table of distributions at some level of significance then the Ho is accepted.

The test as applied here at $\alpha = .01$ with 1 degree of freedom showed that $\chi^2_{calculated} < \chi^2$ $(3.908 < 6.635)$ and therefore accepting Ho becomes tenable.

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